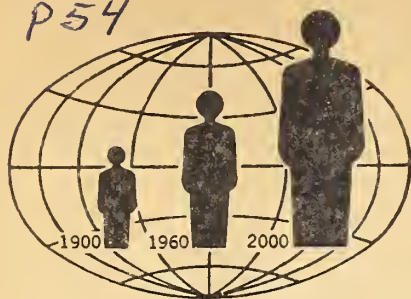


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INTER-RELATIONSHIPS AMONG POPULATION TRENDS, LAND AVAILABILITIES, AND FOOD SUPPLIES

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INTER-RELATIONSHIPS AMONG POPULATION TRENDS,
LAND AVAILABILITIES, AND FOOD SUPPLIES

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1. The precise nature of the intricate inter-relationships among the amount of land available for food production, the size of the human population, and the level of the food supply per person is dependent upon many factors as they inter-act in any local situation. These inter-relationships are much too complex to define and discuss in detail here. Hence, this paper is limited to brief outlines of present food supplies, future demands for food, changes in land availabilities, production potentials, and a conclusion.

Present Food Supplies

2. In two inter-related studies (USDA, 1962, 1964) it was concluded that 30 northern temperate zone countries, with over 900 million people, had nutritionally adequate diets. On the other hand, most of 70 tropical and semi-tropical countries, with over 1900 million people, had diets that were nutritionally inadequate. Consumption of protein in this group of countries was less than two-thirds, and of fat less than one-third, of that in the countries with adequate diets. In most of the countries with inadequate diets, the population was expanding rapidly, malnutrition was widespread and persistent, and there seemed little likelihood that the food problem soon would be solved.

3. In its Third World Food Survey, FAO (1963a) pointed out that at least 20% of the people in the less developed areas are undernourished, 60% are malnourished, and, in the world as a whole, up to half suffer from hunger or malnutrition or both. The nature of the problem may also be seen by reviewing FAO's (1964a) data on food supplies in 49 countries. In these countries, calorie supplies vary from a high of 3510 per person per day in New Zealand to a low of 1800 in the Philippines. Total protein supplies vary from a high of 112 grams per person per day, also in New Zealand, to a low of 42 in both Ceylon and the Philippines. For animal protein, New Zealand also leads with a high of 77 grams, while India has the lowest level - 6 grams. In general, countries that are low in calorie supplies are also low in protein supplies. In turn, those low in total protein are also low in animal protein. However, there are notable exceptions, particularly Turkey and Yugoslavia, and to a lesser extent Greece. These countries, although limited in supplies of animal protein, have substantial supplies of protein from plant sources. In 27 of the 49 countries included in the FAO data, animal protein supplies amounted to less than 30 grams per person per day, and in 10 countries the amount was 15 grams or less.

Future Demands for Food

4. Even the most casual examination of trends in population numbers and of the rapid upsurge the world is now experiencing reveals that the number of mouths to be fed in the year 2000 will be approximately twice the number in 1960.

5. FAO (1963a) concluded that, even to sustain the world's population at its present unsatisfactory dietary level, food supplies would need to be increased by 36% by 1975, 123% by 2000 A.D. If reasonable improvement in nutrition is to be brought about, food supplies would have to be increased by 51% in 1975, 174% in 2000. The latter estimates are based on modest targets per person per day for 1975 and 2000, respectively, as follows: Calories - 2,550 and 2,600; total protein - 75 and 79 grams; and animal protein - 31 and 35 grams. If these targets are to be reached in 1975 and 2000, respectively, supplies of cereals would have to be increased by 35 and 110%, pulses by 85 and 225%, and animal products by 60 and 210%.

6. Since the population will be increasing more rapidly in the less developed, low calorie countries than in the world as a whole, overall food supplies in these countries would need to be increased by 79% in 1975, and 293% in 2000 if an improved level of nutrition is to be achieved; cereals by 40 and 130%, pulses by 100 and 275%, and animal products by 120 and 485%, respectively. These estimates are based upon even more modest targets for 1975 and 2000, respectively: Calories - 2,350 and 2,450; total protein - 69 and 74 grams; and animal protein - 15 and 21 grams.

Changes in Land Availabilities

7. During the many centuries since settled agriculture began, agricultural land has increased as population increased. However, in densely populated countries, little land remains that can be brought under production at reasonable cost. In less-densely populated countries, substantial areas are potentially arable. Just how much could be brought under cultivation economically is not known; the amount would, in fact, change with changing circumstances.

8. Kellogg (1964) cites an estimate by Orvedal of 6,589 million acres of currently arable plus potentially arable land. This is approximately 84 percent more than the approximately 3,580 million acres currently arable and under tree crops (FAO, 1964b). These are not surplus acres, available merely for the taking for crop production. Many areas are inaccessible or, for other reasons, cannot be developed economically at this time. Large areas are under permanent meadows and pastures, or are forested. Removal from such production would adversely affect supplies of animal and forest products; the need for these is increasing, as the population increases, just as is the need for produce of arable and tree crops.

9. However, new lands will be brought under cultivation by plowing grasslands, clearing forested lands, irrigating more desert and semidesert lands, building more polders, and by finding ways to turn tropical forest areas, such as those in the Amazon and Congo basins, into productive farm land. Some forest lands will be cleared for grazing, thus offsetting in part the plowing up of grasslands. But forests may make their own inroads on arable land and grasslands, if intensive plantation forestry expands to meet rising needs for forest products. Also, increasing demands for dwelling space, factories, highways and airports will reduce the amounts of land available for other purposes.

10. Thus, any attempt to assess future land availabilities in precise terms is hampered by the existence of many imponderables. However, to indicate the nature of the problem, there are set out below the changes in amounts of land available per person in the world at 20-year intervals from 1920 to 2000, assuming a fixed land use pattern as of about 1962, based on FAO (1964b) data, and using United Nations (1964) medium projections of world population in 1980 and 2000:

	Acres per person in -				
	1920	1940	1960	1980	2000
Arable and tree crops	1.92	1.56	1.20	.71	.60
Permanent grasslands	3.50	2.84	2.18	1.29	1.09
Forested lands	5.93	4.38	3.35	1.98	1.68
Built on, waste and other lands	7.19	5.83	4.46	2.64	2.24
Totals	18.54	14.61	11.19	6.62	5.61

11. Regardless of efforts to bring new land under cultivation, the inexorable building up of population pressure is such that land available per person for food production must shrink substantially below present levels. For example, even if all the potentially arable land mentioned earlier, which amounts to just over 3,000 million acres, conceivably could be brought under cultivation by 2000 A.D., the amount of arable land per person would be somewhat less than in 1960, while the amounts of pasture and forest lands projected for year 2000 would be substantially lower than the levels shown above because of conversion of some of these lands to crop production. To put the problem another way, land available per person for all purposes in 2000 A.D. (5.61 acres) will be only slightly in excess of the arable and permanent grassland per person (5.42 acres) in 1920.

Production Potentials

12. A United Nations (1958) study points out that the more serious estimates of carrying capacity of the world, subject to particular assumptions made in each instance, have resulted in figures varying from 5,000 million to 16,000 million. Another more recent estimate mentions possible carrying capacities varying from a low of 8,000 to 10,000 million, to a high of 50,000 million (Bonner, 1961).

13. Bonner, when estimating a capacity of 50,000 million, assumed all the reasonably flat, tropical and temperate areas (including deserts, irrigated with reclaimed sea water) might be farmed with an intensity characterized by Japan's modern-day agriculture (which approaches very closely the upper limit of crop yield possible with plants now available; Bonner, 1962), and that all people would be vegetarians. As Bonner (1961) points out, it would be a world twenty times as crowded as today's and could not afford the luxury of pigs, cows, horses, dogs, cats; probably not even strange creatures in zoos.

14. Bonner (1961) also indicated the bases for maintaining 16,000 million, and 8,000 to 10,000 million. For 16,000 million the present Japanese level of productivity would have to spread over all the world's presently cultivated area plus an additional 50%, and all would have to deny themselves the luxury of animal products. At the lower level of 8,000 to 10,000 million, the Japanese level of efficiency would have to be spread over all of Asia, and an agriculture equivalent in efficiency to that of present-day Western Europe would have to be spread over the rest of the world's agricultural lands, which would have in the meantime been expanded by 50%.

15. In its assessment of possibilities of increasing world food production, FAO (1963b) concluded that "the existence of large untapped resources of nature and knowledge represents a challenge to the ability and good will of man to solve a problem which is capable of solution. It does not, however, constitute any guarantee of success and least of all a cause for satisfaction with our current rate of progress." Further, FAO concluded "that a sustained and satisfactory rate of progress will require the allocation of appreciably greater resources for the education of peoples, for research, for physical investment and for international leadership and co-ordination than the nations of the world are making available at present. It will also require a greater willingness to move toward the institutional changes which would provide a more generally favorable climate for productive investment and application of technology."

16. If the steadily rising food needs are to be met, it follows that there must be a steady rise in food production. If such a rise is to be achieved, the preconditions for it must be created. Brown (1965) has characterized the point when such a steady rise can begin as the "takeoff concept" - a concept which had been applied earlier to income - and has set out several preconditions, including: a reasonably high level of literacy; sufficiently high income levels to permit the purchasing of the increasing food supplies; a market-oriented economy in which a substantial portion of farm output is marketed; a strong non-agricultural sector which can provide the fertilizers, pesticides, machinery, and services required; and the essential incentives - including adequate prices for farm products.

Conclusion

17. In the words of J. H. Woodger, "The situation is complicated and its difficulties are enhanced by the impossibility of saying everything at once." Since much must remain unsaid, only the following points are made in conclusion.

18. The world finds itself caught on the prongs of a three-horned dilemma and these three circumstances, in combination, can and may lead to more acute deficiencies in quantity and in quality of diets, as we move through the remaining decades of the Twentieth Century:

a. As United Nations projections indicate, the rapidly rising population curve cannot be expected to plateau during the remaining decades of this century.

b. The land available per person for food production will decrease as the population increases, even though substantial amounts of new land are brought under the plow.

c. Conditions favorable to rapid and steady increases in food production in the less developed, food deficient countries cannot be expected to emerge quickly.

19. The problem is global, but solutions must be tailored to meet national and local situations. Adequate solutions will not be forthcoming unless:

a. National leaders in all countries, and particularly in the food deficit countries, recognize the immensity of the problem and the large and essential role that agriculture must play if both food needs and the requirements of sound economic development are to be met.

b. Recognition of the problem is followed by much more substantial action on many fronts than is now taking place, or is now envisaged in many countries, to develop agricultural resources and to bring agriculture into its essential place in the whole of economic development.

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